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VIII.

OBSERVATIONS ON THE GEOGRAPHY AND  
ARCHÆOLOGY OF PERU.

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READ FEBRUARY 15TH, 1870.

In the year 1863 I was sent to Peru, by the government of the United States, to settle long-standing claims between the two republics, which had several times interrupted their friendly relations. After accomplishing that object, I commenced a series of explorations and investigations in the country, for which my official position gave me some important facilities. These occupied me for two years, and were mainly directed to an illustration of the aboriginal monuments, and an exposition of the archæology of the country. They carried me from Païta, on the north, to Arica, on the south, including a survey of the remarkable remains of Grand Chimú, and the ancient monuments in the valleys of Viru Santa, Nepena, Casma, Supe, Chillón, Rimac, Lurin, Canete, the two Chinchas, Pisco, Arica, etc., etc. From the latter port I crossed the Cordillera to Bolivia, into the great terrestrial basin of Lake Titicaca, visited the enigmatical ruins of Tiahuanaco, the Sacred Islands of Lake Titicaca, and the monuments on its shores, and thence followed the footsteps of the traditional Manco Capac to the imperial city of Cuzco, the capital of the Inca empire, and the Rome of the new world.

From this interesting centre, I made expeditions in every direction, over a radius of a hundred miles, visiting and carefully investigating the vast remains of Ollantaytambo, Pisac, Paucartambo, Muyna, Limatambo, etc., etc.,

and finally directed my steps northward, through Abancay, Andahuylillas, Ayacucho (the ancient Gumanga), nearly to Jauja, when the heavy rains compelled me to descend to the coast at Lima.

It would be impossible for me, in the compass of a single paper, even if it were appropriate before a society of geography, to give a detailed account of the results of my investigations in the rich and wide field of Peruvian archæology. I may, nevertheless, say, I hope, without improper assumption, that these investigations were conducted according to the requirements of modern science, through the aid of the compass, the line, the pencil, and the photographic camera, and will, I think, contribute to remove the subject, to which they principally relate, from the mists of speculation, and put its study on a sure foundation.

Geography, as I have intimated, was a secondary object, or rather an incident, in my explorations, and did not receive very close attention, except where it bore, or was supposed by me to bear, on archæological questions. I should have been delighted to have contributed my efforts to a solution of the geographical problems, of which Peru and Bolivia afford so many examples; to have visited the unexplored lake of the Aullagas, whose conjectural outlines continue to disfigure our maps, to the standing disgrace of the geography of the age; and I should have been still more gratified if, leaving behind me the auriferous frontier province of Carabaya, I could have penetrated into the vast, unknown region through which the Madre de Dios flows, and where popular fancy places the second Inca Empire of Paytiti. But I had neither time nor means to give to these objects, which I hope soon to see taken up with the zeal and devotion that are so rapidly exposing to us the secrets of Africa.

Nevertheless, some of my geographical observations, if not very striking in character, may have importance in correcting existing maps, and increasing the sum of our

information concerning a country little known and very imperfectly delineated. I need not say that no portion of the globe has bolder or more marked geographical and topographical features than Peru. In no part of the world does Nature assume grander, more imposing, or more varied forms. Along the Pacific coast is a belt of desert, intersected here and there by narrow valleys of wonderful fertility, or relieved, near the mountains, by *oases* not less fertile. Succeeding this belt, inland, is the declivity of the Cordillera, notched by gorges, through which flow streams of varying size, fed by melting snows or the rains that fall, for part of the year, in the interior. On the coast, except as a remarkable meteorological phenomenon, rain never falls—a fact bearing in a marked manner on the aboriginal architecture of that region. Ascending the escarpment of mountains, we find a grand elevated ridge or mountain billow, bristling with snowy and volcanic peaks, and often spreading out in broken, cold, and arid plains or *Punas*, with little of life to relieve their forbidding monotony. This broad and frozen belt, called *El Despoblado*, varying from 14,000 to 18,000 feet in height, is succeeded, in the south of Peru and Bolivia, by the great terrestrial basin of Lakes Titicaca and Aullagas, which is completely shut in by the Andes and the Cordillera. Above, or to the northward of this, the two ranges separate again, forming the vast Andean Plateau, the Thibet of America, deeply grooved by streams which all find their way eastward into the Amazon.

The American continent affords three conspicuous examples of that interesting physical phenomenon, the Terrestrial Basin, with its own fluvial system and its own water reservoirs. First, the great Utah basin, with its Salt Lake; second, the smaller basin of Lake Itza, in Central America; and third, the vaster, more elevated, and in all respects more interesting basin of Lake Titicaca. The limits of this basin, on the south, are not yet

accurately determined, but, calculating from the Pass of La Raya, on the north, in latitude  $14^{\circ} 50'$ , and longitude  $70^{\circ} 50'$  west of Greenwich, it may safely be estimated to have a length of between 500 and 600 miles. Its width, calculated by the reach of the streams which concentrate in it, varies from 100 to 200 miles, and may be taken to average not far from 150 miles, thus giving a total area of about 100,000 square miles. Its eastern border is bounded by the loftiest section of the Andes—a vast, unbroken, snow-crowned range, whose lowest peaks rival Chimborazo in altitude, with the gigantic mass of Illampu or Sorata at one extremity, and the scarcely less imposing bulk of Illamini at the other.

The slope of the Titicaca basin is gentle towards the south. In its northern and highest portion reposes Lake Titicaca, a magnificent body of fresh water, comparable only with the North American lakes in respect of size, and lying at the extraordinary elevation of nearly 13,000 feet above the sea. It receives several considerable tributaries, some of which are scarcely fordable even in the dry season, and discharges its waters through a broad, deep, and swift, but not turbulent stream, El Desaguadero, into Lake Aullagas. This stream is about 170 miles long, and has a fall of not far from 500 feet in its course, a fact which sufficiently disproves the old story, that the two lakes are so nearly on the same level that sometimes the waters flow from the one into the other, and *vice versâ*. Of Lake Aullagas, as I have intimated, we know next to nothing. The most that seems to be established is that it has no visible outlet to the sea. That it receives the drainage of Lake Titicaca; that its principal feeder, the Desaguadero, is swollen by some considerable streams, after leaving Lake Titicaca, and that it has itself a number of important feeders, we know. Its size, contour, depth, and the possible disposition of its affluence of waters are open questions. It must be of vast superficies indeed, if its excess of water be carried

off, as has been suggested, by evaporation. Altogether, I regard Lake Aullagas as offering the most interesting geographical problem for the solution of the explorer on the whole American continent.

Lake Titicaca, from its size, altitude and relation to the extraordinary terrestrial basin to which it gives a name, and in which it is so conspicuous a feature, is, perhaps, the most remarkable body of water in the world. It is a long, irregular oval in shape, with one-fifth of its area nearly cut off by the opposing peninsulas of Copacabana and Tiquina. Its greatest length is not far from 120 miles, and its greatest width between forty and fifty miles. Its mean level is 12,864 feet above the sea, but varies a little with the seasons. Its outline, as well as its general features, and the most conspicuous points on its shores, were very accurately fixed by J. B. Pentland, formerly British Consul-General in Bolivia, who visited it in 1827-28, and again in 1837.

His observations are embodied in a chart published by the British Admiralty, entitled "Map of Lake Titicaca, with the Valleys of Yucay, Collao and Desaguadero," which I have elsewhere substantially reproduced, with some corrections of my own. I spent three weeks on this lake in an open boat, in company with Prof. Raimondi, a gentleman of high scientific attainments, and can bear testimony to the general accuracy of Mr. Pentland's observations. Further on I shall take the liberty of correcting some of his more considerable errors, merely remarking here that, considering the difficulties which the traveler has to encounter among the high Andes, it is only surprising that his mistakes are so few.

The eastern or Bolivian shore of Lake Titicaca is abrupt, the mountains often pressing down boldly into the water. The western and southern shores, however, are relatively low and level, and the water here, especially in the bays and estuaries, is shallow and grown up with reeds and rushes, among which myriads of water-fowls find shelter

and support. A large part of these low grounds are still marshy, and the roads are carried across them on stone causeways of Inca origin. A fall of ten feet, in the mean level of the lake, would, perhaps, lessen its area by one-fifth. It would lay bare most of the large bay of Puno, and a very large part of the bays of Tiquina and Guaqui. It is easy to see that the lake once covered a much larger area than it now occupies. It must not be supposed, however, that it is generally shallow; on the contrary, it is, in many places, very deep, soundings being beyond the reach of a line of 100 fathoms.

I have said that the level of the lake varies with the seasons. In the dry or winter season it is from three to five feet lower than during the summer or wet season. This rise and fall of the water certainly contributes to the support of the herds of cattle that, during the period of rains, find food in the vast pastures of Puno, the ancient Collao. As already observed, in the shallow parts of the lake grow wide belts of reeds, and a kind of tender lake-weed, called, in the Quichua language, *Uacta*, on which cattle eagerly feed. This weed grows luxuriantly, reaching the surface from depths of from ten to twelve feet. When the dry and cold season comes on, and the grass of the pasture becomes sere and dead, the cattle flock to the lake to subsist on this plant or weed. Soon that portion of it nearest the shore is consumed, and then commences a process which, if we accept certain theories regarding the law of adaptation, may, sooner or later, convert the cattle of the Puno into hippopotami! They press into the water until their backs are barely visible, and the line between the water they have cleared and the mat of weeds beyond indicates the line of four or more feet soundings as clearly as if it were laid down in a chart. As the water of the lake subsides, the line is pushed further on, until the recurrence of the rains revives the pastures and the waters of the lake rise to their former level. Were it not for this resource, the

department of Puno could not well support, through the winter, the herds of cattle that now constitute a principal part of its wealth.

The lake never freezes over, but ice forms near its shores and where the water is shallow. In fact, the lake has an important influence on the climate of this high, cold and desolate region. Its waters, at least during the winter months, are from ten to fifteen degrees of Fahrenheit warmer than the atmosphere. Its islands and peninsulas feel this genial influence most perceptibly; and I found barley, peas and maize—the latter, however, small and not prolific—ripening on them, while they did not mature on what may be called the mainland.

The prevailing winds on the lake are from the northeast, whence they often blow with great force, and the waves roll in on its western and southern shores with something of the force and majesty of those of the ocean. Severe storms are not unfrequent, rendering navigation on the frail *balsas* or rafts of *totorá* or reeds, always slow and precarious, exceedingly dangerous. Great but misdirected efforts have been made to place steamers on the lake, and portions of two small ones of iron have been for seven years in the town of Puno. A great drawback to their success will be the want of fuel, of which there is very little, in the shape of stunted *quenúá* or wild olive-trees, growing on the more sheltered parts of the island. I was, however, shown some specimens of very good bituminous coal, said to have been found on the peninsula of Copacabana, but was unable to visit the alleged deposit.

Lake Titicaca has several considerable bays, of which those of Puno, Huancané and Achacache are the principal, and it has also eight considerable islands which are habitable or inhabited, viz., Amantené, Taqueli, Soto, Titicaca, Coati, Campanario, Taquari and Aputo. Of these the largest is Titicaca, high and bare, ragged in



outline as rugged in surface, six miles long by between three and four miles in width.

This was the sacred island *par excellence* of Peru. To it the Incas traced their origin, and to this day it is held by their descendants in profound veneration. According to tradition, Manco Capac and Mama Oella, his wife and sister, children of the Sun and commissioned by that luminary, started hence on their errand of beneficence to reduce under government, and instruct in religion and the arts, the savage tribes that occupied the country. Manco Capac bore a golden wand, and was directed to travel northward until he should reach the spot where the rod would sink into the ground, and there fix the seat of his empire. He traveled slowly along the western shore of the lake, through the broad and bleak Puna lands, up the valley of the Rio Pucura to the Lake of La Raya, where the basin of Titicaca ends, and whence the waters of the Rio Vilcanota start on their course to swell the Amazon. He descended the valley of that river, until he reached the spot where Cuzco now stands, where the golden rod disappeared. Here he fixed his seat, and here, in time, rose the City of the Sun, the capital of his empire, the shrine of religion, and the center of his power.

Upon this island, the traditional birthplace of the Incas, are still the remains of a temple of the Sun, a convent of priests, a royal palace, and other evidences of Inca civilization. It is easy to find the shallow cave, under a huge shelf of sandstone, where Manco Capac took shelter until he received his high commission, and which was venerated beyond any object in the Inca empire. In the warmest and most sheltered nook of the island is a garden of the Incas, with its baths and its fountains still flowing with silvery sheen and murmur. Not far from Titicaca is the island of Coati, sacred to the moon, on which stands the famous Palace of the Virgins of the Sun, built around two shrines dedicated to the sun and the moon,

respectively, and which is one of the best preserved and most remarkable remains of aboriginal architecture in America. The island of Soto was the Isle of Penitence, to which resort was had for fasting and humiliation. In common with all the other islands I have named, it has considerable remains of ancient architecture.

The population around Lake Titicaca is, of course, almost exclusively Indian. The Aymaras largely predominate, the Quichua language being confined to a part only of the inhabitants of the town of Puno, and those living between Puno and Huancané. There is a marked difference between the Aymaras and Quichuas physically, although their languages have many features in common. The former are a smaller, darker, more sullen and incommunicative race than the latter, who, in my opinion, constituted the dominating or Inca family in the empire of Manco Capac.

I have said that the map of Lake Titicaca and its environs, by Mr. Pentland, is, beyond comparison, the best extant. In fact, later travelers have been content to adopt it, with few, if any, additions or corrections. And I am sure that its industrious and conscientious author will be glad if I can, in any degree, contribute to the perfection of his elaborate and excellent work. In this belief I wish to point out some of his most conspicuous errors.

While the outlines of the lake, as given by Mr. Pentland, may be considered as approximately exact, it will be obvious, to the traveler on the spot, that the space between the island of Titicaca and the Bolivian shore is far too narrow, and that the Bay of Tiquina is much too small. My observations, made with a view of determining this point, have not yet been reduced, but I have no doubt they will substantiate what I now say.

The courses of some of the rivers falling into the lake, as represented in the map, are also quite inexact. The River Pucura, or Ramis, rising in the Lake of La Raya,

is well laid down. But the map errs in making the considerable river of Azangaro, which rises in the mountains toward Carabaya, fall direct into the lake, a little to the eastward of the mouth of the Ramis. This is quite another stream, the Putina, while the Rio Azangero is a tributary of the Ramis, and unites with it a few miles above the town of Taraco. Between the Putina and Ramis, but discharging into the latter, is the considerable Lake of Arapa, more than ten leagues in circuit, and also the salt lake, Laguna de Salinas, which, however, like many other of the Andean lakes, has no outlet. Neither of these lakes is indicated in Mr. Pentland's map, which is also wrong in making the Rio Lampa, which receives the streams that descend from the lakes of the Pass of La Compuerta, in the Cordillera, enter the Lake of Titicaca a little to the west of the mouth of the Ramis. So far from this being the case, the Lampa falls into the northern extremity of the Bay of Puno. The Lake of Umayo, which is represented as discharging into the Rio Lampa, has, in fact, no outlet. It is a singular lake, deeply sunk in the rocky plateau, but yet considerably elevated above the level of Lake Titicaca itself. It abounds in fishès, one variety of which, sent by me to Prof. Agassiz, is believed to be entirely new, and, possibly, peculiar to the lake in question. It is on a peninsula projecting boldly into this lake that we find the remarkable group of ancient burial towers, known as the *Chulpas* of Sillustani.

Before turning away from the rather ungrateful task of indicating or correcting errors, I may observe that the course of the nameless stream, flowing past the town of Santiago de Machaca, on the road from Tacna to La Paz, is not to the south-east, as represented by Mr. Pentland, but northeast, reaching the Desaguadero above Nasacara, and not falling into the Rio Maure. There are other mistakes in Mr. Pentland's map, and, consequently, in those of the travelers who have copied it, which I hope to correct

in my own map, of which, however, that of Mr. Pentland must form the basis as well as the most important part.

Mr. Pentland has correctly indicated the little lake of La Ray, occupying the very crest of the "divide," or Pass of La Raya, as being the common source of the Rio Pucura, flowing into Lake Titicaca, and the Rio Vilcanota, which, under its different names of Vilcamayo, Urubamba and Ucayali, constitutes unquestionably the Rio Madre, or mother stream, of the Amazon. This little lake is only a few hundred yards across, and springs up in a depression in the "divide," among masses of bog or turf, with snowy mountains on every side. A cork thrown into the center of the lake might find its way northward into the Amazon, or southward into Lake Titicaca, depending, probably, on the direction of the wind. I am happy to confirm Mr. Pentland's accuracy as regards this lake, and the more so since the question of lakes with two outlets has called out some discussion in connection with African travel. Mr. Pentland fixes the altitude of the Lake of La Raya at 13,380 feet above the sea. I think this altitude, like most of the others given by this authority, is below the fact. The altitudes, given by Mr. David Forbes, of some of the mountains of Peru and Bolivia are considerably greater than those given by Mr. Pentland, and conform better with those which I have myself determined. For full and authentic information on these points, however, as well as upon the geography, zoology, botany, geology and mineralogy of Peru, we must await the publication of Prof. Antonio Raimondi's researches in that country, where he has spent twenty years in the collection of data, with a zeal, intelligence and industry impossible to be surpassed.

While speaking of the source of the Amazon, I may perhaps be indulged in some observations on that great river, and the plans and attempts that have been recently made to utilize it by the people dwelling on its upper

waters, and for bringing the vast regions which it drains within the circle of colonization and modern development. The Amazon, or, as it is called on the spot, El Amazonas, is understood to be formed by the union of the great rivers Marañon and Ucayali, near the Peruvian establishment of Nauta. It has been a question which of these streams may be considered as the Rio Madre, or main river, and whether that name should be given to the longest stream, having its rise furthest from the point of junction, or to that which carries the greatest volume of water. As regards length, there is no doubt that the Ucayali exceeds the Marañon by several hundreds of miles, whether its longest branch be the Urbamba or Vilcamayo rising in the Lake of La Raya, or the Apurímac, rising in the province of Caylloma, department of Arequipa. As regards volume, we can only accept the evidence of those who have had opportunities of making a comparison. Our latest authority, on this as on some other interesting points, is Dr. Santiago Távora, a member of the Hydrographic Commission, sent out in 1868, by the Peruvian government. After reaching Nauta, at the junction of the Marañon and the Ucayali, he writes : "The Marañon is not the main stream of the Amazon. To deserve that distinction it should have greater length and a greater volume than the Ucayali ; it has neither, and leaves the latter to bear, without dispute, the title of Rio Madre del Amazonas."

The Ucayali, besides the interest attaching to it as the Rio Madre del Amazonas, has lately been invested with special importance, through the active explorations of the Amazonian tributaries reaching into Peru, by the government of that republic, and by enterprising and adventurous individuals. It has long been the dream of Peru, but more especially since the introduction of steam, in some way to utilize the Amazonian waters, by establishing, through them, a direct communication between the populated highlands of the Peruvian interior and the

Atlantic coast and Europe. Obviously such a communication, if practicable, would be of great advantage to that region, and might lead to its ultimate development. After, however, what I have seen and learned of interior Peru and its real capacities, I must say I am not inclined to share in the high anticipations that have been indulged in, regarding its future, by writers, native and foreign. Up to within a very recent period it was believed that the interior might be reached by four great highways,—first, by the Purûs, which flows into the Amazon in latitude  $3^{\circ} 50'$  south, longitude  $61^{\circ} 17'$  west, and was supposed to reach to the province of Corabaya, department of Puno, and take its rise in the snowy region of the Andes, bounding the basin of Titicaca on the north-east. It was supposed to flow thence, and, under the name of Madre de Dios, pass through the important province of Cuzco, less than 100 miles to the east of that city, and to constitute, from its head of navigation, wherever that might prove to be, the natural highway of Southern Peru, *viâ* the Amazon, to the Atlantic. The investigations of Don Faustino Maldonado, who lost his life in making them, and of Prof. Raimondi, have proved, however, that the streams of Carabaya, and the Madre de Dios itself are affluents of the Beni, which in turn is an affluent of the Madeira, or else themselves flow direct into the Madeira. In either case they must reach that river above its falls, which are not transitable for steamers.

The next great river, penetrating Peru from the Amazon is the Purûs, which, as I have said, was supposed to reach close to Cuzco. This has been thoroughly explored by an adventurous Englishman, Mr. Wm. Chandless, who has ascertained that its navigable waters do not come near the Andes, nor approach anywhere within practicable communication with the settled parts of Peru. The same may be said of the comparatively small rivers intervening between the Purûs and the Yavari, which latter,

for a considerable part of its length, forms the boundary between Peru and Brazil.

Our principal, indeed our only knowledge of the Yavari is derived from the reports of the mixed Peruvian and Brazilian Boundary Commission that undertook its ascent in the autumn of 1866. They reached a point, at an estimated distance of 1,000 miles from the mouth of the river, when they were driven back with loss, by the Indians. Captain Carrasco, the Peruvian Commissioner, reports it navigable for steamers of small draft to the mouth of an affluent that he calls Rio Galvez, a distance, calculated from his observations, of about 300 miles from the Amazon.

The Amazon now enters wholly into Peruvian territory, where it has been for some years traversed by Peruvian steamers in conjunction with a Brazilian line below. At Nauta, 500 miles from the frontier, it loses its distinctive name, and separates, as we have seen, into two large tributaries, the Marañon and the Ucayali. The Marañon, at a distance of about 200 miles above the junction, receives a large affluent from the south, the Huallaga, which reaches to the heart of the Department of Junín, close to the celebrated mining town of Cerro de Pasco. This was explored by our countryman, Lieut. W. L. Herndon, in 1851, who reported it navigable for a draught of five feet, at the lowest stage of the river, to Chasuta, or Pongo de Aguiré, 285 miles from its mouth, and for canoes from that point to Tingo María, a further distance of 325 miles. Prof. Raimondi, publishing in 1862, states, however, that the Huallaga, notwithstanding its great volume of water, is so obstructed that it cannot be steadily navigated by steamers of useful burden except to La Laguna, twenty-five miles from its mouth. It may, nevertheless, be navigated, at certain seasons, to the town of Yurimaguas.

The word *pongo* is a corruption of the Quichua *puncu*, portal or gateway, and indicates rapids or falls between

high escarpments of rocks, realizing what we have lately had described to us as the *canons* of the Colorado.

One of these *pongos*, the famous one of Manseriche, where the whole volume of the Marañon, which above that point is 1,800 feet wide, is forced between the precipitous rocks in a broken trough less than 200 feet broad, and with a current of fourteen miles an hour, effectually precluding steam navigation beyond. This *pongo* is about 400 miles above Nauta, and it is only to that point, where there is little population, that the Marañon can be regarded as a fluvial highway.

Coming back now to Ucayali, we find that, after all, it is the only stream likely to meet, in any great, practical sense, the idea of permanent or rapid communication between Peru, the Amazon and the Atlantic, or in its probable usefulness, as well as in length and volume, to indicate its right to the designation of Rio Madre del Amazonas. Like the Amazon, it takes its name only from the point where its two great tributaries, the Urubamba or Vilcamayo and the Tambo, itself formed by the Apurimac, and the Mantaro, come together. For its whole length, from the point of junction down to the Amazon a distance of 772 miles, it is a navigable river for steamers of large size and draft. The Urubamba, according to Castelnau, is navigable for small vessels for 216 miles, in the direction of Cuzco, to certain falls 180 miles below the Indian village of Echaraté, 220 miles from Cuzco, the capital of the most populous department of Peru, and with which, more than any other, it is important to establish communication from the Amazon. A sanguine German has proposed a railway up the valley of the river, from the head of steam navigation to the town of Urubamba, twenty-four miles from Cuzco, in the glorious valley of Yucay, but this would involve a road 400 miles long; but as two well-filled freight-trains a year would now carry away all the surplus produce of the department, and one car a month the total number of its travel-



ing citizens, I fear the project will not command the capital requisite for its realization.

The extent to which the Tambo, and after it the Apurimac and Mantaro, are or may be made navigable, I will not undertake to say. It has not been explored. Prof. Raimondi has penetrated, with infinite difficulty, from Huanta to the junction of the two rivers just named, when the united streams had sufficient water, in his estimation, to admit the use of small steamers all the year round. This point, according to the same authority, is in longitude  $72^{\circ} 32'$  west, and latitude  $12^{\circ} 30'$  south; and as the point of junction of the Tambo and Vilcamayo, or Urubamba, as recently fixed, is in longitude  $73^{\circ} 14'$  west, and latitude  $10^{\circ} 41'$  south, it follows that, if Prof. Raimondi is right, the Tambo is navigable for at least 250 miles.

The Ucayali is, therefore, following its windings, navigable, in connection with the Vilcamayo, 988 miles, and in connection with the Tambo, 1,022 miles; and as from its mouth to that of the Amazon is 2,609 miles, the total of navigation is 3,731 miles.

No attempt, however, has been made to utilize the Ucayali, except recently, and only so far as to establish steam connection with the department of Junin, by way of the River Pachitea, a considerable branch of the Ucayali, and the Palcazu, a tributary of the Pachitea. In June, 1866, an expedition, under Capt. Vargas, was sent from the Peruvian establishment of Iquitos, on the Amazon, to explore those rivers. He embarked in a little iron steamer, the Putamayo, of seventy tons register, twenty-five horse-power, and drawing only two feet of water. It safely navigated the Ucayali to the mouth of the Pachitea, and had ascended the latter stream about sixty miles, when two of its officers, Senores Tavara and West, who had gone ashore to communicate with the Indians on its banks, were attacked and slain. Owing to this circumstance—the steamer, meantime, having

suffered some damage by grounding—the expedition turned back.

A new and more effective expedition was, however, speedily organized by the young and enthusiastic Prefect of the Department of Loreto, Don Benito Arana, which embarked in three steamers, the Morona, drawing seven to eight feet of water, the Napo and the little Putamayo, already mentioned. It reached the point on the Pachitea whence the Putamayo had turned back, December 6, 1866, where a force was landed to chastise the Indians who had murdered Tavara and West. A number were killed and their village burned. The expedition then pushed forward, not without difficulty from narrows and shallows, and on the 8th of December reached the mouth of the Palcazu, and entered it for a short distance, when the Morona, the largest steamer, was compelled to stop for want of water, while the other two proceeded still a little farther on to the mouth of an affluent of the Palcazu, the Mairo, where it was proposed to establish a port, as the head of navigation, to be called, after the then president, Puerto Prado. The expedition remained a few days, dispatching a glowing account of its success to the government, by which it was proclaimed to the world that, as Mairo, or Puerto Prado, was only ten days distant from Lima (or but 325 miles), a direct route might be considered established, viâ the Amazon, between the Pacific and the Atlantic, between Lima and Para—the whole capable of being traversed in twenty-two days—twelve days being the time allowed by the enthusiastic Prefect Arana, in his official report, for the passage from Puerto Prado to the mouth of the Amazon, the whole distance, as was alleged, being practicable for vessels of 500 tons.

The expedition, on returning, was not so successful. The water of the Pachitea fell rapidly, and the Putamayo, which was the last descending, got aground, and remained aground for upwards of a year, or until the 12th of January, 1868.

Early in the year 1867, and in order to determine, with scientific accuracy, the capability of the route pointed out by the Prefect Arana, the Government of Peru appointed a Hydrographic Commission, a member of which was Dr. Santiago Tavara, brother of one of the officers already mentioned as having been killed by the Indians on the first trip of the Putumayo. His report, recently published, has just reached me from Lima.

This commission consisted of seven persons: three Americans, three Peruvians and one Swiss, with Admiral John R. Tucker, formerly of the United States Navy, but now in the Peruvian service, at its head. Starting from the so-called *Puerto Prado* in canoes and on rafts, they descended to the Pachitea in an hour, and the latter river to the Ucayli in six days, when they embarked on the steamer Morona, and in seven days, anchoring at night, reached the Amazon. Capt. Tucker subsequently ascended the Ucayali, making a regular survey of the river to the junction of the Tambo and Vilcamayo. He ascended the latter thirty-five and the former five miles, making all necessary observations for a map of this great river. His report is not yet published, and we only know some of the results from Dr. Tavara's pages.

From these we gather that from Puerto Prado to the Ucayali, following the Pachitea, is 195 miles; from the mouth of the latter to the Amazon, following the Ucayali, 575 miles.

The mouth of the Ucayali is in latitude  $4^{\circ} 30'$  south, longitude  $73^{\circ} 5'$  west of Greenwich.

The mouth of the Pachitea in latitude  $8^{\circ} 48' 28''$  south, longitude  $74^{\circ} 7' 40''$  west.

The junction of the rivers Vilcamayo and Tambo in latitude  $10^{\circ} 41'$  south, longitude  $73^{\circ} 14'$  west.

Dr. Tavara pronounces against Puerto Prado as a port, on the ground that the Palcazu is not properly a navigable stream, and is decided in his conviction that the head of navigation is at some point much lower down on the

Pachitea. Nor is he at all enthusiastic in favor of the proposed route to the Amazon, but strongly favors that proposed by the Viceroy Abascal in 1808, namely, by way of the Rio Chanchamayo, which, uniting with the Tutumayo and Pangoa rivers, forms the Perene, an important tributary of the Rio Tambo, entering it not far above the junction of the latter with the Vilcamayo. He thinks the Perene navigable to a point called Quimiri, not far from the frontier fort of San Ramon, sixty leagues from Lima. He estimates the distance from this point to the Ucayali at less than a hundred miles.

The government of Peru, with commendable spirit, sent last year (1869) an expedition under a Mr. Nystrom, a German, to explore this route. He penetrated only seven miles beyond Fort San Ramon, where his party became involved in a fight with the savage Chunchas, and he himself in a quarrel with the military officers accompanying the expedition, which consequently broke up without any valuable results. I believe the attempt to solve the question of a communication by this route has been renewed. If it should prove feasible, it will be clearly the best of all yet proposed to connect habitable Peru with the Amazon, especially as it starts close from the populous district of Tarma, which it is proposed to connect with Lima by railway,—a daring, but, it is believed, a feasible undertaking. A railway, on the other hand, to the Pachitea, is probably impracticable, although there have been engineers of sufficient hardihood to propose one from Lima to Cerro de Pasco, elevated 14,000 feet above the sea.

I cannot omit from these notes of what has been done and is doing in Peru, in the way of geographical exploration, without a reference to the liberality of its government in sending an exploring expedition up the Rio Morona, through its own territory into that of Ecuador. A citizen of the latter republic, a Senor Proano, under certain authorizations from his government, professed to

have discovered that the Morona was navigable to within 129 miles of the River of Guayaquil. Peru accordingly undertook to explore the Morona, and the steamer Napo succeeded in reaching a point at the confluence of two streams, the Lamar and Sucre Maisal and Cusilime, in the heart of the eastern ramifications of the Equatorian Andes, and, according to the report, "within two and a half degrees of the Guayaquil river. Senor Proano asserts the practicability of a railway to connect these two rivers.

The extent to which the conditions of mankind are influenced by natural circumstances, and how these may dictate, not alone the architecture and arts of a people, but their social, religious and political organizations, is, perhaps, nowhere better illustrated than in Peru. The Inca empire, it seems to me, was only rendered possible by the peculiar geographical and topographical positions occupied by the family or families that were its founders. Long antedating that empire, its vast area contained a great number of communities, tribes or principalities, more or less advanced or civilized, separated from each other, however, on the coast, by hot and almost impassable deserts, and in the interior by lofty mountains, or cold and trackless *punas*. They had but little intercourse or political dependence, and they all, when by means of alliance or conquest the enterprising families around Cuzco became consolidated, fell an easy prey to those inhabitants of the high, strong fastnesses or *bolsones* of the Andes. From their dominating position, the Incas were enabled to throw overwhelming forces successively on the isolated valleys radiating from their mountain center, and, one by one, mould them into the grandest of aboriginal American empires. It is easy to see how ambition, and the exigencies arising out of their aggressions, should have developed, gradually, that astute policy or statesmanship, that ability in

organization and administration, of which the Incas furnished such a remarkable example.

That portion of the Andean plateau lying between the Pass of La Raya, at the northern extremity of the Titicaca basin and the Pass of La Banda, near Pasco, is a great mountain-encircled region, drained by the River Ucayali, itself, as we have seen, formed by the Vilcamayo, Apurimac and Pampas flowing north, and the Mantaro flowing south. The beds of these streams are deep and narrow, being merely gigantic canals or drains for the waters collected in numberless vales among the mountains. Nothing better describes these vales than the Spanish word *bolson*, or pocket. And, as I have said, while the valleys of the coast are separated by deserts, these *bolsones* are isolated by ranges of hills, mountains, or uninhabitable *punas*, and all these are divided into groups by the great rivers, which, like the Apurimac, are intransitable except by the aid of bridges of *mimbres*, or cables of braided withes swinging dizzily in mid-air.

These *bolsones* are of varying altitudes, and, consequently, of various climates or productions. Some are well drained, others are marshy and contain considerable lakes. They discharge their gathered waters, often in large streams that plunge, in numberless cataracts, through dark and narrow ravines into the gorges of the great rivers. The passage from one *bolson* to another is over the intervening elevated ridges and *punas*, frequently among frost and snow, and always by rocky and difficult paths, fit only for the vicuna and the llama.

It was in precisely one of these *bolsones*, the central one of a group or cluster lying between the Vilcamayo river and the Apurimac, that the Incas built their capital. It is not only central in position, salubrious and productive, but the mountain barriers that separate it from its neighbors are relatively low, and subside into passes that may be traversed with comparative ease, while they are,

at the same time, readily defensible. The rule of the first Inca does not seem to have extended beyond this valley, and the passes leading into it are strongly fortified with works that face outward, indicating the directions whence attack was possible in the early days of the empire, before the chiefs of Cuzco commenced their career of conquest by reducing the people of the *bolson* of Anta or Xaxiguana on the north, and of Urcos or Andahuaylillas on the south.

The *bolson* of Cuzco, which is not far from thirty miles long, is divided into two nearly equal parts by the Pass of Angostura, or the Narrows, where two mountain spurs project towards each other into the valley, leaving hardly room enough for the roadway and the river. On the promontories dominating this narrow passage are the conspicuous ruins of many buildings and remains of works, showing that this was regarded as a strategic or important position, for the immediate protection of the capital.

The city of Cuzco, which occupies the site of the ancient capital, stands at the northern or most elevated extremity of the *bolson* or valley, on the lower slopes of three high hills, the Carmenca, Sacsahuaman and Cantuta, where as many rivulets, the Almodena, Huatenay and Tullamayo or Rodadero, coming together like the outspread fingers of the hand, unite to form the Cachamayo, which drains the valley, and falls into the Urubamba. The old city, or rather that part of it dedicated to the royal family, was built on the tongue of land falling off from the hill or headland of the Sacsahuaman, between the Huatenay and the Rodadero.

The position of the city, as determined by Mr. Pentland, is latitude  $13^{\circ} 31'$  south and longitude  $72^{\circ} 2'$  west of Greenwich; its elevation above the sea 11,380 feet. Surrounded by high and snowy mountains, it might be supposed to have a cold, not to say frigid, climate; but in fact its temperature, though cool, is seldom freezing,

and although in the dry season, or what is called winter, from May to November, the pastures and fields are sere and the leaves fall from all but quenua trees, yet all this is rather from drought than frost. On the whole, the climate is equable and salubrious. Wheat, barley, maize and potatoes ripen in the valley, and the strawberry, apricot and peach are not unknown. The climate of Nismes, and of the south of France generally, is much the same with that of Cuzco during the summer months. When we add to those favorable conditions that not more than thirty miles distant are deep, hot valleys, where semi-tropical fruits may be produced abundantly, we may comprehend that Cuzco was not an unfavorable site for a great capital.

Its geographical position, as regards the country at large, as I have said, was also such as to make it a citadel and the dominating center of an empire. Its very name, if we credit the chroniclers, signified *umbilicus*. The Inca power once fairly established in the cluster of valleys, of which I have spoken, and with the few and narrow passes by which only they can be reached, strongly fortified as they were, it was comparatively easy, as I have already said, for the Incas to overwhelm the inhabitants of the long and narrow valleys running down the slopes of the Andes and the Cordillera, and to subdue, one by one, the families dwelling in the *bolsones* northward to the equator; and southward beyond the desert of Atacama—an extent of thirty-seven degrees of latitude.

We are told that Cuzco, in its construction and arrangement, was a *microcosm* of the Inca empire, and, in common with the country at large, was divided into four quarters by four great roads running in the direction of the cardinal points. The roads do not, however, take these directions, but run intermediately to them. The road extending north-east and south-west from Cuntisuya to Antisaya bounded the Huacapta, or great square, as will be seen by the plan, on its south side, and divided the



city into two very nearly equal parts ; the more elevated part, in the direction of the hill and fortress of the Sacsahuaman, being called *Hanan*, or Upper Cuzco, and the lower part *Hurin*, or Lower Cuzco. Grouped around the central square, in the form of an oval, were no less than twelve subdivisions, or *barrios*, the names of most of which are still retained. The most important part of the sacred city was the spur of the hill of the Sacsahuaman, extending down between the rivulets Huatenay and Rodadero—a tongue of land, calculating from the terraces of the Colcompata, where the first Inca built his palace, to the confluence of the two streams, a mile in length by a quarter of a mile broad. Within this area, on ground sloping to the valley in front, and to the rivulets on either hand, the royal *aylllos*, or lineages, had their residences. Here were the palaces of the Incas, the buildings dedicated to instruction, the great *galpones* or edifices in which festivals were held, the convent of the Virgins of the Sun, and situated far down toward the Pumapchupam, or tail of the Tiger, in the district called *Coricancha*, or Place of Gold, the gorgeous temple dedicated to the sun, with its chapels sacred to the moon, the stars, the thunder and the lightning. It was here, after the Conquest, that the conquistadors obtained their *repartimientos* of land, and on the ruins of the Inca palaces reared their own *parvenu* edifices. Over the imposing gateways of the Inca dwellings, which they preserved as entrances to their own, we still find, carved or stuccoed, the arms of Pizarro, Almagro, Gonzalez, Quinones, Valdivia, and Toledo. By a coincidence, perhaps not wholly accidental, the convent of Santa Catalina was raised on the site, retaining in great part the very walls, of the *Acllahuasa*, or palace of the Vestals of the Sun, and the temple of the Sun itself became the convent of the monks of Santo Domingo.

All over this narrow tongue of land we still find the evidences of ancient greatness, as exhibited in Inca archi-

texture, which here, as elsewhere, has an individuality as marked as that of any nation on earth. The streets of the new city are almost coincident with those of the old, and are defined by long sections of Inca walls, built of stones elaborately cut, and fitting together with an accuracy not excelled in any of the structures of Greece or Rome, and which modern art may emulate, but cannot surpass.

I made a careful survey of Cuzco, with the aid of two engineers, Messrs. Davis and Church, and have laid down in the map before you, in red, the remains of the walls of the ancient buildings. Of the temple of the Sun, the convent of the Vestals, the palaces of Yupanqui and the Inca Rocca, and of the alleged palace of Manco Capac himself, as well as of the *yachahuasi*, or schools, important and often imposing vestiges still exist, of which I have accurate plans. Enough of the temple of the Sun remains to determine its plan and character. But it would be impossible for me to go into any detailed account or description of these remarkable structures, or of the others which have justly given to Cuzco the title of the Rome of the New World, and made it, archæologically, the most interesting city of America.

I cannot, however, close these very discursive observations without a single reference to the great fortress of the Sacsahuaman, which dominated the city of Cuzco, the stronghold of its rulers, the work of three reigns, and which the chroniclers characterized as the eighth great wonder of the world. I present you with an accurate plan of the work, the result of a careful survey, with enlarged horizontal sections showing its gateways, and vertical sections showing its construction.

This fortress is built on the bold headland extending into the valley of Cuzco, between the rivulets Huatenay and Rodadero. This headland, which rises 760 feet above the great plaza of the city, looks from below like a high, abrupt hill; but it is really only a projection of

a narrow, irregular plateau, which, in turn, is commanded by higher hills, or apparent hills, themselves the escarpments of remoter terraces.

Towards the city, the eminence of the Sacsahuaman presents a steep and almost inaccessible front, up which, from the terraces of the Colcompata, led anciently, as now, a zigzag road, ascending in places by steps, to a series of terraces on the most projecting and conspicuous portion of the headland. The usual ascent, practicable by horses, is through the gorge or ravine of the Rodadero. The mass of the hill is a metamorphic rock, hard in parts, and disintegrating in others, thrust up by igneous action from below, and bearing on its surface huge blocks of limestone from the neighboring cliffs, a tumultuous piece of natural rock-work, which it would require an accomplished geologist to describe. Back of the headland is a level area or plain, in which rise the amphibolic rocks called "El Rodadero." In this direction the Sacsahuaman presents a front curving slightly inward, and it is along this face that the heaviest works of the fortress were raised. They remain substantially perfect, and will remain so, unless disturbed by a violence not to be anticipated, and of which the present inhabitants of Cuzco seem hardly capable, as long as the Pyramids shall last, or Stonehenge and the Coliseum endure; for it is only with these works that the fortress of the Sacsahuaman can be properly compared.

The defenses consist of three lines of massive walls, each supporting a terrace and a parapet. These walls are nearly parallel, and have approximately accurate entering and re-entering angles, for their total existing length of 1,800 feet. The first or outer wall has an average present height of twenty-five feet; the second wall is about thirty feet behind it, and is eighteen feet high; the third wall is about eighteen feet behind the second, and in its highest part has fourteen feet of elevation. The total elevation of the walls is, therefore, about fifty-seven feet.

I am speaking exclusively of the walls on the northern front of the fortress. Long lines of walls extend along the heights dominating the gorge of the rivulet Rodadero, and there are sections of walls on the brow of the hill on the side of the city. As these were constructed of regular, squared stones, they have been almost wholly destroyed, the stones having been rolled down the eminence and used for buildings in the modern city.

A remarkable feature in the construction of the fortress, on its only assailable side, is the conformation with modern defensive structures in the employment of salients, so that the entire face of the walls could be covered by the enfilading fire of the defenders. This feature is not the result, in any degree, of the conformation of the ground, but of a clearly settled plan.

The stones composing the walls are massive blocks of blue limestone, irregular in size and shape, but accurately fitted together, the whole forming, without doubt, the grandest specimen of the style called *cyclopean* in all the Americas, if not in the world. The outer wall is most massive. Each salient terminates in an immense block of stone, sometimes of the height of the terrace it sustains, but generally supporting one or more other blocks only less in size than itself. One of these stones is twenty-seven feet high, fourteen broad, and twelve in thickness. Stones of fifteen feet length, twelve feet width and ten feet in thickness are common. All the stones are slightly beveled or rounded on the face, but cut down sharply toward the joints, as we see in some of the Florentine palaces. They fit together with wonderful precision. The inner walls are of smaller and more regular stones.

Each wall supports a terrace or platform, and the summit of each was anciently crowned with a parapet. The chroniclers speak of only three gates; but there were five in all. The main entrance was near the center of the line of walls, where one salient was omitted, so as to leave a rectangular space, sixty-three feet long by twenty-five

feet wide. In the center of the left-hand end of this space, between two enormous blocks of stone, was and is an opening four feet wide, in which are steps leading up to the first terrace. The entrance through the second wall is more intricate, and opens against a transverse wall, where the steps turn at right angles, and thus reach the second terrace. The third wall has a double entrance, one plain like that through the first, and the second corresponding with that through the second or intermediate wall. The lesser entrances, to the right and left of the principal one just described, are simple openings occurring not opposite each other, but in alternating salients. The chroniclers state that these various gateways were closed by closely-fitting blocks or slabs of stone, and, in fact, some of these remain.

The ground within the walls rises to a further elevation of sixty feet, and is rocky. Several blocks of metamorphic rock and limestone project above the soil, and are cut into gradients, and otherwise carved. Here are fragments of the foundations of considerable structures, of regularly cut stones, but of which the plans cannot now be made out—the remnants, probably, of what the chroniclers describe as three small fortresses or citadels within the greater work. The declivities of the whole interior of the fortress seem to have been graduated by terraces, faced with cut stones, of which, however, few remain, although many of the terraces are themselves distinct. Prescott has given the name of “The Fortress” to the three towers alleged to have existed on the hill of the Sacsahuaman, and mistakes in supposing that there were but two lines of walls on the side next the rocks of the Rodadero. Water was conducted into the fortress through *azequias* and subterranean passages, some of which still exist and are in use.

I have said that the stones composing this fortress are limestone, and that masses of the same still lie within its walls, and on the plateau behind it. That some of those

entering into the construction of the work were taken from their natural positions near the places where they now stand is most probable ; but that most of them were brought from the limestone cliffs or quarries, on the edge of the superior plateau, is certain. Two distinct, well-graded roads still exist, leading to these quarries. Hewn blocks still lie by the side of these roads; and others remain in the quarries themselves. The great *pedra cansada* or *Sayacusca*, of which Garcilasso and others speak, as having required 20,000 men to move it, and which, in rolling over, killed 300 workmen, is an enormous mass of rock weighing 1,000 tons or more, and certainly was never moved by human hands. Its top, as are the summits of hundreds of other rocks on the plateau of the Rodadero, is cut into what appear to be seats, and reservoirs of every shape, and its sides are cut into niches and stairways, the whole forming a maze of incomprehensible sculpture and apparently idle but elaborate labor.

It is a mistake of Garcilasso that the Fortress of Cuzco could not be commanded, not even by artillery. It is commanded in great part by the heights of the Rodadero, and entirely by the adjacent hill of Cantuta. Still, it was no doubt an impregnable fortress under the system of warfare practiced in ancient times.

From this brief sketch of the Fortress of Cuzco, I think you will agree with me, that it is one of the most remarkable single, independent, aboriginal structures in America. There are other works like the Fortress of Ollantaytambo, and like the mountain stronghold of Pisac, that cover greater areas ; but they are rather aggregations of works, and do not have that individuality and salience possessed by the Fortress of the Sacsahuaman.

I must, in conclusion, ask the indulgence of the Society for presenting a paper so hurried, discursive and incomplete as this. It would, perhaps, have been better to have confined myself to a single point ; but, in a field so rich,

archæologically and geographically, as Peru, it would be difficult, if not impossible, to make a selection of such a point, or to treat it independently of its necessary and intimate relationships. I hope, however, that at no distant day I shall be able to lay before the Society and the world the matured results of my researches in a country which scholars as eminent and travelers as enterprising as Condamine, Castelneau, D'Orbigny, Von Tschudi, Sartiges, Angrand, Weddell, Desjardins, Boellart, Forbes, Markham and Raimondi, have found so worthy of their labors, and which yet offers so wide a field to the explorer and the student.